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(71)Applicant : SEMICONDUCTOR ENERGY LAB CO LTD

(72)Inventor : MIZUKAMI MAYUMI
KONUMA TOSHIMITSU
YAMAZAKI SHUNPEI

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(54) LUMINESCENT ORGANIC COMPOUND AND EL DISPLAY DEVICE USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a highly reliable EL display device.

SOLUTION: By subjecting a luminescent organic compound to purification treatment for a several times, a thin film comprising the luminescent organic compound shows an ionic impurity content of ≤0.01 ppm and a volume resistivity of ≥3×1010 Ωcm. By employing the thin film as a luminescent layer of an EL element, electric currents other than the electric current generated through recombination of carriers are inhibited, and therefore a deterioration caused by heat generation may be inhibited.

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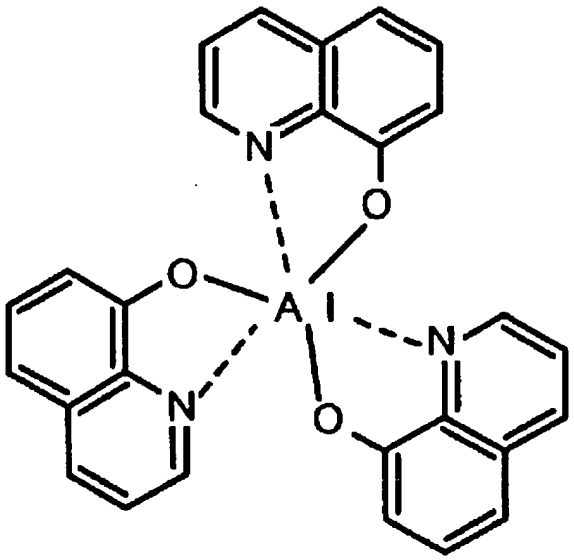
DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the luminescent organic compound (the complex which contains a metal in a molecular formula is also included) with which electroluminescence (EL:Electro Luminescence) is acquired, and EL display using it. Typically, it is related with the macromolecule system EL display using the luminescent organic compound which consists of a high molecular compound.
[0002] Moreover, it is related with the electronic instrument which has the EL display as a display. In addition, the above-mentioned EL display is also called OLED (Organic Light Emitting Diodes).
[0003]
[Description of the Prior Art] In recent years, development of the display (EL display) using EL layer as a spontaneous light corpuscle child using EL phenomenon is progressing. Since EL indicating equipment is a spontaneous light type, its back light like a liquid crystal display is unnecessary, and since the angle of visibility is still larger, it is promising as a display of the pocket mold device used outdoors.
[0004] The luminous layer used as a part for the radical headquarters of an EL element is an insulating material, pours in a carrier (an electron and electron hole) into a luminous layer by applying an electrical potential difference to the cathode and the anode plate which sandwich a luminous layer, and obtains luminescence by the recombination of a carrier. That is, the current which flows a luminous layer is a current resulting from the recombination of a carrier. As an EL ingredient which can be used for EL display, the ingredient of a publication is, for example in JP,2-311591,A.
[0005] By the way, in the light emitting device in which semi-conductor junction of light emitting diode etc. was formed, since Na (sodium) which poses a problem as movable ion will lower the resistance of a luminous layer, it can become the factor which passes currents other than the current resulting from the recombination of a carrier. If the current besides such need flows, calorific value will increase, and degradation of a luminous layer will be promoted. Also in an EL element, the same thing can pose a problem. However, in the present condition, it cannot be said in EL ingredient that the cure to such movable ion is enough.
[0006]
[Problem(s) to be Solved by the Invention] This invention makes it a technical problem to offer reliable EL display. And let it be a technical problem to offer an electronic instrument with the high dependability of a display by using such an EL display as a display.
[0007]
[Means for Solving the Problem] In this invention, in order to make it currents other than the current resulting from the recombination of a carrier not flow, the volume resistivity of the thin film which consists of a luminescent organic compound contained in an EL element is set to 1x1011 to 1x1012-ohmcm (preferably 1x1012 to 1x1013-ohmcm). Moreover, in order to attain such a volume resistivity, concentration of the ionicity impurity in the thin film which consists of a luminescent organic compound

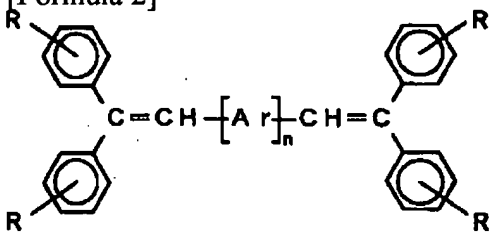
is set to 0.1 ppm or less (preferably 0.01 ppm or less). In addition, an ionicity impurity points out sodium (Na) or a potassium (K) to the element and representation target belonging to one group of a periodic table, or two groups.
[0008] Therefore, in order to attain the above-mentioned configuration, it is necessary to use the luminescent organic compound whose ionicity impurity contained is 0.1 ppm or less (preferably 0.01 ppm or less).
[0009] If the above-mentioned concentration is converted into the concentration in the case of sodium, it will become three or less (preferably three or less 7x1016 atoms/cm) 7x1017 atoms/cm. However, it is appropriate to the concentration of an ionicity impurity to consider as the concentration of the sum total of all ionicity impurities.
[0010] What is necessary is just to refine this low-molecular system EL compound by zone refining, a sublimation purification method, the recrystallizing method, distillation, the filtration process, column chromatography, or the reprecipitating method, if the luminescent organic compound (henceforth a low-molecular system EL compound) which consists of a low molecular weight compound is used in order to obtain the luminescent above-mentioned organic compound.
[0011] However, since width of face arises in molecular weight since polymerization degree cannot be completely controlled when using the luminescent organic compound (henceforth a macromolecule system EL compound) which consists of a high molecular compound, and the melting point is not decided uniquely, purification becomes difficult. In this case, dialysis or a high-speed-liquid-chromatography method is suitable. The electrodialysis process is suitable for removing an ionicity impurity efficiently in dialysis especially.
[0012] in addition, the above -- even if it uses which purification means, in order to reduce an ionicity impurity to 0.1 ppm or less, it is necessary to repeat a purification process two or more times, and to perform it 5 times or more are preferably desirable at least 3 times or more. Of course, it not only repeats the same purification approach, but you may use the two or more purification approaches.
[0013] Moreover, when using a filtration process, a 0.1-micrometer aperture (it is also called a ****** aperture) and the thing which has a 0.05-micrometer aperture preferably are desirable as a filter. That is, if it is a 0.1-micrometer aperture, a path will not let the matter 0.1 micrometers or more pass. Moreover, if it is a 0.05-micrometer aperture, a path will not let the matter 0.05 micrometers or more pass.
[0014] As mentioned above, the description is to form the EL element containing the thin film which consists of a luminescent organic compound whose volume resistivity is 1x1011 to 1x1012-ohmcm (preferably 1x1012 to 1x1013-ohmcm) using it, and produce [produce the luminescent organic compound whose concentration of the ionicity impurity contained in this invention is 0.1 ppm or less (preferably 0.01 ppm or less),] EL display.
[0015] in addition, the luminescent organic compound used for this invention -- as a low-molecular system EL compound, the thing of 1x102 - 8x102 g/mol (typically 3x102 - 5x102 g/mol) is used, and molecular weight should just use [molecular weight] the thing of 8x102 - 2x106 g/mol (typically 1x104 to 1x105g/(mol)) as a macromolecule system EL compound.
[0016] As a typical low-molecular system EL compound which can be used for this invention, Alq3 (tris-8-quinolinolato aluminum complex) is mentioned. A molecular formula is as follows.
[0017]
[Formula 1]



[0018] Elsewhere, the JISUCHIRU arylene amine derivative which added the amino permutation DSA may be used for DSA (JISUCHIRU arylene derivative). DSA is expressed with the following molecular formulas.

[0019]

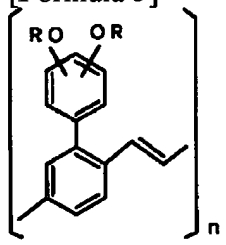
[Formula 2]



[0020] Moreover, although PPV (polyphenylene vinylene) is mentioned as a typical giant-molecule system EL compound which can be used for this invention, there is a thing of various molds. For example, the following molecular formulas are announced. "H.Shenk, H.Becker, O.Gelsen, E.Kluge, W.Kreuder, and H.Spreitzer, "Polymers for Light Emitting Diodes", Euro Display, Proceedings, 1999, p.33-37"

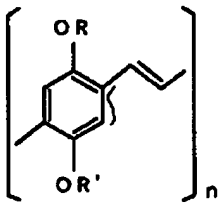
[0021]

[Formula 3]



[0022]

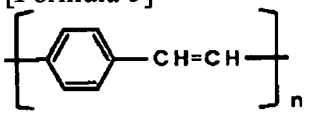
[Formula 4]



[0023] Moreover, the polyphenyl vinyl of the molecular formula indicated by JP,10-92576,A can also be used. A molecular formula is as follows.

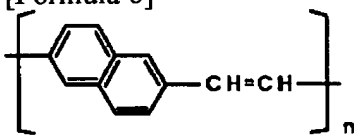
[0024]

[Formula 5]



[0025]

[Formula 6]



[0026] As for the approach of forming a thin film using such a macromolecule system EL compound, various **** of a spin coat method is a desirable approach in the simplicity of an activity. After a spin coat method melts to a solvent the solute which forms a thin film and applies the solution by a spinner etc., it is a means to volatilize a solvent by BEKU processing (baking processing), and to form a thin film.

[0027] In this invention, the solvent containing a macromolecule system EL compound is applied by the spinner, heat treatment is added below at the temperature (specifically below glass transition temperature) which a macromolecule system EL compound does not crystallize, and a solvent is volatilized. Consequently, on a substrate, the thin film which consists of a macromolecule system EL compound is formed.

[0028] Moreover, a luminescent organic compound is weak into oxygen, and, as for the electric conduction film prepared after forming the thin film which consists of a luminescent organic compound, it is desirable to form so that it may not be exposed to the environment where the thin film which consists of a luminescent organic compound contains moisture and oxygen. Therefore, it can be said that it is desirable to be carried out with the same thin film deposition system as for formation of the electric conduction film used as the formation and cathode of a thin film, or the anode plate which consists of a luminescent organic compound.

[0029] In order to attain the above-mentioned demand, it is suitable to use the thin film deposition system of a multi chamber method. In this invention, it is desirable to produce reliable EL display using such a thin film deposition system.

[0030] It can prevent currents other than the current which originates in the recombination of a carrier by considering as a configuration [like] above in the part of the thin film which consists of a luminescent organic compound contained in an EL element flowing, and degradation by unnecessary generation of heat can be prevented. Therefore, it is possible to obtain reliable EL display. Moreover, the reliable electronic instrument of a display is obtained by using such an EL display for the display of an electronic instrument.

[0031]

[Embodiment of the Invention] The gestalt of operation of this invention is explained using drawing 1 .

In drawing 1 , 101 is a substrate which has an insulating front face, and can use the glass substrate which prepared the insulator layer in an insulating substrate or front faces, such as a quartz substrate, a ceramic substrate, a crystallization glass substrate, a metal substrate (preferably stainless steel substrate), or a plastic plate.

[0032] A pixel 102 is formed on a substrate 101. In addition, although drawing of the three pixels is carried out in drawing 1 , actual much more pixels are arranged in the shape of a matrix. For example, if it is 640x480 pieces and an XGA class when it is a VGA class, it will become 1024x768 pieces. Two TFT(s), TFT103 for switching and TFT104 for current control, are respectively formed in a pixel 102. At this time, the drain of TFT103 for switching is electrically connected to the gate of TFT104 for current control. Furthermore, the pixel electrode (it serves as the cathode of an EL element in this case) 105 is electrically connected to the drain of TFT104 for current control. In this way, a pixel 102 is formed.

[0033] each wiring and the pixel electrode of TFT -- low -- what is necessary is just to form using a metal membrane [****] It is good to use the aluminium alloy film here. Moreover, TFT of what kind of structure may be used as TFT. Of course, you may be well-known structure.

[0034] If even the pixel electrode 105 forms, the compound (said to be catholyte) 106 containing the low metal of a work function will be formed on all pixel electrodes. Since this has about several nm and thin thickness, since it is unknown, it shows the profile for whether it is formed in the shape of a layer, and whether island shape is dotted by the dotted line.

[0035] As an ingredient of the compound containing the low metal of the above-mentioned work function, lithium fluoride (LiF), lithium oxide (Li2O), barium fluoride (BaF2), the barium oxide (BaO), a calcium fluoride (CaF2), a calcium oxide (CaO), a strontium oxide (SrO), or caesium oxide (Cs2O) can be used. They seem not to cause pixel inter-electrode short-circuit (short circuit), even if formed in the shape of a layer since these are insulation.

[0036] Of course, although it is also possible to use the ingredient which has well-known conductivity like a MgAg electrode instead of a compound, it is necessary to prepare alternatively or to perform patterning so that pixel electrodes may not short-circuit.

[0037] On the compound 106 containing the low metal of a work function, the EL layer (thin film which consists of a luminescent organic compound) 107 is formed. Although the EL layer 107 can use a well-known ingredient and structure, it uses the possible ingredient of white luminescence in this invention. As structure, only by the luminous layer (thin film which consists of a luminescent organic compound) which offers the place of recombination, it is good also as an EL layer and the laminating of an electronic injection layer, an electronic transportation layer, an electron hole transportation layer, an electronic blocking layer, an electron hole component layer, or the hole injection layer may be carried out if needed. In this specification, it is called EL layer including all the layers in which impregnation of a carrier, transportation, or recombination is performed.

[0038] Moreover, the luminescent organic compound used for the EL layer 107 may be a low-molecular system EL compound, or may be a polymer system (macromolecule system) EL compound. However, it is desirable to use the polymer system EL compound which can be formed by the easy membrane formation approaches, such as a spin coat method and print processes. In addition, the structure of drawing 1 is the color display method which combined EL layer and the color filter of white luminescence. Moreover, the color display method which combined blue, or EL layer and the fluorescent substance (the color conversion layer of fluorescence: CCM) of bluish green luminescence, and the method which performs color display by piling up EL layer corresponding to RGB are also employable.

[0039] The description of this invention is in the point using the luminescent organic compound refined by even purity very high as a luminous layer here. All the purification approaches well-known as the purification approach can be used. For example, what is necessary is just to use zone refining, a sublimation purification method, the recrystallizing method, distillation, column chromatography, or the reprecipitating method, if it is a low-molecular system EL compound. Moreover, what is necessary is just to use dialysis or high speed liquid chromatography, if it is a macromolecule system EL compound.

In addition, in the case of a macromolecule system EL compound, before carrying out a polymerization, the same purification as a low-molecular system EL compound is performed, and it can also take means to carry out a polymerization on it.
[0040] Moreover, when refining a macromolecule system EL compound with dialysis, it is good to use an electrodialysis process especially for removing an ionicity impurity.
[0041] Dialysis pays the macromolecule system EL ingredients which carried out the polymerization to semipermeable membrane (semi-permeablemembrane), such as a cellulose, and pays them into the solvent (for example, pure water). Semipermeable membrane is supported between the batches of a usually fine wire gauze, or is made to adhere to a porous base material like the disk of sintering glass, and is fixed. An electrical potential difference is applied between the batches of the wire gauze supporting semipermeable membrane, migration of an ionicity impurity becomes quick, and an electrodialysis process can be refined efficiently.
[0042] It carries out by repeating the above-mentioned purification, and the ionicity impurity contained in the thin film which consists of a luminescent organic compound is made to be set to 0.1 ppm or less (preferably 0.01 ppm or less) in this invention. The volume resistivity of the thin film which consists of a luminescent organic compound which functions as a luminous layer by considering as the above-mentioned density range serves as 1x1011 to 1x1012-ohmcm (preferably 1x1012 to 1x1013-ohmcm). The current which originates in factors other than recombination of a carrier by this can be prevented from flowing.
[0043] In addition, when EL layer becomes only by the luminous layer (i.e., when it is only the thin film which consists of a luminescent organic compound of a monolayer), the concentration of an ionicity impurity is 0.1 ppm or less (preferably 0.01 ppm or less), and a luminous layer should just fulfill the conditions of 1x1011 to 1x1012-ohmcm (preferably 1x1012 to 1x1013-ohmcm) in a volume resistivity.
[0044] Of course, in the phase which forms the phase and it which refine the luminescent organic compound which forms EL layer, it is necessary to pay careful attention so that an ionicity impurity may not mix from an external ambient atmosphere.
[0045] Thus, on the formed EL layer 107, the transparence electric conduction film is formed as an anode plate 108. As transparence electric conduction film, it is possible to use the compound (referred to as ITO) of indium oxide and the tin oxide, the compound of indium oxide and a zinc oxide, the tin oxide (SnO2), or a zinc oxide (ZnO).
[0046] Moreover, on an anode plate 108, an insulator layer is prepared as passivation film 109. As passivation film 109, it is desirable to use a silicon nitride film and the nitriding oxidation silicon film (expressed with SiOxNy).
[0047] The substrate completed so far is called a active-matrix substrate on these specifications. That is, the substrate with which the EL element (capacitor which consists of catholyte, an EL layer, and an anode plate) which uses as cathode the pixel electrode electrically connected to TFT and this TFT and its pixel electrode was formed is called a active-matrix substrate.
[0048] Furthermore, as an EL element is enclosed with a active-matrix substrate, the opposite substrate 110 is stuck, and a light-shielding film 112 and color filters 113a-113c are formed in the opposite substrate 110. That is [it forms a light-shielding film 112 so that the clearance 111 which looks at from / of a watcher / a look (the direction of a normal of an opposite substrate) at this time, and the pixel electrode 105 makes may be hidden], it prepares so that it may see from [of an opposite substrate] a normal and a light-shielding film 112 and the edge of a pixel may be in agreement. This is because electric field can become complicated and light cannot be made to emit with desired brightness or a desired chromaticity at that the part is the nonluminescent section and the edge of a pixel electrode.
[0049] That is, the profile between pixels can be made clear by forming a light-shielding film 112 in the location corresponding to the edge (edge) and clearance 111 between the pixel electrodes 105. In addition, in this invention, since the profile of a pixel electrode is in agreement with the profile of a pixel, it can be said that the light-shielding film 112 is formed in the location corresponding to the edge of a pixel. Moreover, the location corresponding to the edge of a pixel points out the location which is in agreement with the edge of a pixel along the direction of a normal of the above-mentioned opposite

substrate.
[0050] Moreover, color filters 113a-113c are color filters with which green and 113c extract [113a / red and 113b] a blue light. These color filters are formed in the location corresponding to a pixel 102, and can change the color of the light which this takes out for every pixel. Theoretically, it is the same as that of the colorization method of the liquid crystal display using a color filter. In addition, the location corresponding to a pixel points out the location which is in agreement with a pixel along the direction of a normal of the above-mentioned opposite substrate. That is, it prepares so that it may see from [of an opposite substrate] a normal and color filters 113a-113c and each pixel corresponding to it may be in agreement.
[0051] However, a color filter is a filter which raises the color purity of the light penetrated by extracting the light of specific wavelength. Therefore, when the amount of [of the wavelength which should be taken out] Mitsunari is few, the fault of being as color purity being bad **** [, and] may be produced. [that the brightness of the light of the wavelength is extremely small] Therefore, although there is no limitation in EL layer of white luminescence which can be used by this invention, it is desirable to include red with purity high as much as possible and a green and blue emission spectrum in the spectrum component of white luminescence.
[0052] In addition, the above-mentioned color filters 113a-113c can also be made to contain drying agents, such as barium oxide, like a light-shielding film 112. In this case, what is necessary is just to let the resin film which made red, and green or blue a pigment and a drying agent contain be a color filter.
[0053] By the way, although not illustrated here, the opposite substrate 110 is stuck on the active-matrix substrate by the sealing compound, and the space shown by 114 is a closed space. This closed space 114 may be filled up with inert gas (rare gas and nitrogen gas), and may be filled up with an inactive liquid. Moreover, it may be filled up with the adhesives of translucency and the whole substrate may be pasted up. Furthermore, it is desirable to prepare drying agents, such as barium oxide, in this closed space 114. Since the EL layer 107 is very weak for moisture, it is desirable to make it moisture not trespass upon a closed space 114 as much as possible. Furthermore, it is effective to fill up with the inactive liquid with which crown ether or cryptand is contained. Since crown ether has the capacity which combines with sodium and is captured, the gettering effectiveness is expectable.
[0054] As an opposite substrate 110, it is necessary to use the substrate of translucency so that advance of light may not be barred. For example, a glass substrate, a quartz substrate, or a plastic plate is desirable. Moreover, what is necessary is just to use the high thin film of protection-from-light nature, such as resin containing a black pigment or carbon, and titanium film, as a light-shielding film 112. Moreover, it is also effective to use the resin which contained the drying agent as a light-shielding film 112.
[0055] The concentration of the ionicity impurity in the thin film with which EL display of this invention which becomes with the above configurations consists of a luminescent organic compound is 0.1 ppm or less (preferably 0.01 ppm or less), and a volume resistivity is 1x1011 to 1x1012-ohmcm (preferably 1x1012 to 1x1013-ohmcm). Therefore, except the current resulting from the recombination of a carrier, since it does not flow but degradation by excessive generation of heat is suppressed, it is reliable.
[0056] Thus, reliable EL display is obtained by carrying out this invention. And a reliable electronic instrument is obtained by using such an EL display as a display.
[0057] Moreover, the light emitted from the EL element penetrates an opposite substrate, is emitted, and EL display of this invention goes into a watcher's eyes. Therefore, a watcher can recognize an image from an opposite substrate side. At this time, the description of EL display of this invention is the point of forming a light-shielding film 112 first so that the clearance 111 between the pixel electrodes 105 may be hidden between an EL element and a watcher. Thereby, the profile between pixels will become clear and the high definition image display of it will become possible.
[0058] Moreover, a light-shielding film 112 and a color filter 113 are formed in the opposite substrate 110, and the opposite substrate 110 serves also as the function as a sealing material which controls degradation of an EL element. Although a membrane formation process and a patterning process will

increase and the part yield will fall if a light-shielding film 112 and a color filter 113 are formed in a active-matrix substrate side, the yield fall of a active-matrix substrate can be suppressed by preparing in an opposite substrate.
[0059] Moreover, like this invention, a light-shielding film 112 and a color filter 113 are formed in the opposite substrate 110, and the structure of pasting up an opposite substrate and a active-matrix substrate by the sealing compound further has a point common to the structure of a liquid crystal display. That is, it is possible to divert almost all the production lines of an existing liquid crystal display to some other purpose, and to produce EL display of this invention, and reduction of a synthetic manufacturing cost is possible by reducing plant-and-equipment investment sharply.
[0060]
[Example] The example of [example 1] this invention is explained. Here, how to produce to coincidence TFT of a picture element part and the drive circuit prepared around it is explained. However, in order to simplify explanation, suppose that the CMOS circuit which is a basic circuit is illustrated about a drive circuit.
[0061] First, as shown in drawing 2 (A), the substrate film 301 is formed on a glass substrate 300 at the thickness of 300nm. In this example, as substrate film 302, the laminating of the nitriding oxidation silicon film is carried out, and it is used. At this time, it is good to make into 10 - 25wt% nitrogen concentration of the direction which touches a glass substrate 300.
[0062] Next, the amorphous silicon film (not shown) with a thickness of 50nm is formed by the well-known forming-membranes method on the substrate film 301. In addition, what is necessary is just the semi-conductor film (the microcrystal semi-conductor film is included) which does not need to limit to the amorphous silicon film and includes amorphous structure. The compound semiconductor film which furthermore includes the amorphous structure of the amorphous silicon germanium film etc. is sufficient. Moreover, thickness should just be 20-100nm in thickness.
[0063] And the amorphous silicon film is crystallized with a well-known technique, and the crystalline substance silicon film (it is also called a polycrystal silicone film or the polish recon film) 302 is formed. As the well-known crystallization approach, there are the heat crystallization approach which used the electric heat furnace, a laser annealing crystallizing method using laser light, and the lamp annealing crystallizing method using infrared light. In this example, it crystallizes using the excimer laser light which used XeCl gas. In addition, although the excimer laser light of the pulse oscillation mold processed into the line is used in this example, you may be a rectangle and the argon laser light of a continuous-oscillation mold and the excimer laser light of a continuous-oscillation mold can also be used.
[0064] Moreover, when using Nd-YAG laser (wavelength of 1.06 micrometers), the 2nd higher harmonic wave or the 3rd higher harmonic wave is used, the beam made into the shape of a line or a rectangle according to optical system can be irradiated, and the above-mentioned semi-conductor film can be made to crystallize it with the energy density of 100 - 500 mJ/cm2.
[0065] Although the crystalline substance silicon film is used as a barrier layer of TFT in this example, it is also possible to use the amorphous silicon film. Moreover, it is also possible to form the barrier layer of TFT for switching with the need of reducing the OFF state current, by the amorphous silicon film, and to form the barrier layer of TFT for current control by the crystalline substance silicon film. Since the amorphous silicon film has low carrier mobility, the OFF state current cannot flow easily that it is hard to pass a current. That is, the advantage of both sink or cone crystalline substance silicon film can be efficiently employed [a current] for the pile amorphous silicon film and a current in a sink.
[0066] Next, as shown in drawing 2 (B), the protective coat 303 which becomes by the oxidation silicon film is formed on the crystalline substance silicon film 302 at the thickness of 130nm. What is necessary is just to choose this thickness in 100-200nm (preferably 130-170nm). Moreover, other film is sufficient as long as it is an insulator layer containing silicon. This protective coat 303 is formed in order to enable concentration control delicate in order not to put the crystalline substance silicon film to the direct plasma, in case an impurity is added.
[0067] And the resist masks 304a and 304b are formed on it, and the impurity element (henceforth n

mold impurity element) which gives n mold through a protective coat 303 is added. In addition, Lynn or arsenic can be used for the element and type target which belong to 15 groups typically as an n mold impurity element. In this example, Lynn is added by the concentration of 1x1018 atoms/cm3 using the plasma doping method which carried out plasma excitation without carrying out mass separation of the phosphoretted hydrogen (PH3). Of course, the ion implantation method for performing mass separation may be used. In n mold impurity ranges 305 and 306 formed of this process, a dose is adjusted so that n mold impurity element may be contained by the concentration of 2x1016 - 5x1019 atoms/cm3 (typically 5x1017 - 5x1018 atoms/cm3).

[0068] Next, as shown in drawing 2 (C), the element which removes a protective coat 303 and belongs to 15 groups who added is activated. Although an activation means should just use a well-known technique, it is activated by the exposure of excimer laser light by this example. Of course, a pulse oscillation mold or a continuous-oscillation mold may be used, and it is not necessary to limit to excimer laser light. However, since activation of the added impurity element is the purpose, it is desirable to irradiate with the energy which is extent which the crystalline substance silicon film does not fuse. In addition, laser light may be irradiated, with the protective coat 303 attached.

[0069] In addition, activation by heat treatment may be used together on the occasion of activation of the impurity element by this laser light. What is necessary is just to perform heat treatment of about 450-550 degrees C in consideration of the thermal resistance of a substrate, when performing activation by heat treatment.

[0070] The boundary section (joint) with the field which has not added n mold impurity element which exists in the edge of n mold impurity ranges 305 and 306, i.e., the perimeter of n mold impurity ranges 305 and 306, according to this process becomes clear. This means that a LDD field and a channel formation field can form a very good joint, when TFT is completed behind.

[0071] Next, as shown in drawing 2 (D), the unnecessary part of the crystalline substance silicon film is removed, and the island-shape semi-conductor film (henceforth a barrier layer) 307-310 is formed. And as shown in drawing 2 (E), barrier layers 307-310 are covered and gate dielectric film 311 is formed. What is necessary is just to use 10-200nm of insulator layers which contain silicon with a thickness of 50-150nm preferably as gate dielectric film 311. Monolayer structure or a laminated structure is sufficient as this. In this example, the nitriding oxidation silicon film of 110nm thickness is used.

[0072] Next, patterning of the electric conduction film of 200-400nm thickness is formed and carried out, and the gate electrodes 312-316 are formed. The edge of these gate electrodes 312-316 can also be made into the shape of a taper. In addition, in this example, a gate electrode and wiring for leading about electrically connected to the gate electrode (henceforth gate wiring) are formed with another ingredient. concrete -- a gate electrode -- low -- an ingredient [****] is used as gate wiring. Even if micro processing of this is impossible for gate wiring using the ingredient in which micro processing is possible as a gate electrode, it is for wiring resistance to use a small ingredient. Of course, a gate electrode and gate wiring may be formed with the same ingredient.

[0073] Moreover, although a gate electrode may be formed by the electric conduction film of a monolayer, it is desirable to consider as cascade screens, such as a bilayer and three layers, if needed. All electric conduction film well-known as an ingredient of a gate electrode can be used. However, the ingredient in which patterning is possible in line breadth of 2 micrometers or less is possible [micro processing] as mentioned above and specifically desirable. Typically A tantalum (Ta), titanium (Ti), molybdenum (Mo), A tungsten (W), chromium (Cr), the film that becomes by the element chosen from silicon (Si), or the nitride film (typical -- the tantalum nitride film and the nitriding tungsten film --) of said element The titanium nitride film, the alloy film (typically a Mo-W alloy, a Mo-Ta alloy) which combined said element, or the silicide film (typically tungsten silicide film, titanium silicide film) of said element can be used. Of course, it may use by the monolayer, or a laminating may be carried out and you may use.

[0074] In this example, the cascade screen which becomes by the nitriding tungsten (WN) film of 50nm thickness and the tungsten (W) film of 350nm thickness is used. What is necessary is just to form this by the spatter. Moreover, if inert gas, such as Xe and Ne, is added as sputtering gas, film peeling by stress

can be prevented.
[0075] At this time, the gate electrodes 313 and 316 are formed so that it may lap through gate dielectric film 311 with a part of n mold impurity ranges 305 and 306, respectively. This overlapping part serves as a LDD field which lapped with the gate electrode behind.
[0076] Next, as shown in drawing 3 (A), n mold impurity element (this example Lynn) is added in self align by using the gate electrodes 312-316 as a mask. In this way, in the impurity ranges 317-323 formed, it adjusts so that Lynn may be added by the concentration of 1 / 2 - 1/10 of n mold impurity ranges 305 and 306 (typically 1 / 3 - 1/4). Specifically, the concentration of 1x1016 - 5x1018 atoms/cm3 (typically 3x1017 - 3x1018 atoms/cm3) is desirable.
[0077] Next, as shown in drawing 3 (B), the resist masks 324a-324d are formed for a gate electrode etc. in a wrap form, and the impurity ranges 325-331 which add n mold impurity element (this example Lynn), and include Lynn in high concentration are formed. It carries out by the ion doping method for having used phosphoretted hydrogen (PH3) also here, and the concentration of Lynn of this field is adjusted so that it may become 1x1020 - 1x1021 atoms/cm3 (typically 2x1020 - 5x1021 atoms/cm3).
[0078] Although the source field or drain field of the n channel mold TFT is formed of this process, in TFT for switching, it leaves a part of n mold impurity ranges 320-322 formed at the process of drawing 3 (A).
[0079] Next, as shown in drawing 3 (C), the resist masks 324a-324d are removed, and the resist mask 332 is newly formed. And p mold impurity element (this example boron) is added, and the impurity ranges 333 and 334 which contain boron in high concentration are formed. Here, boron is added so that it may become 3x1020 - 3x1021 atoms/cm3 (typically 5x1020 - 1x1021 atoms/cm3 NO) concentration by the ion doping method for having used diboron hexahydride (B-2 H6).
[0080] In addition, although Lynn is already added by impurity ranges 333 and 334 by the concentration of 1x1020 - 1x1021 atoms/cm3, the boron added here is added by the concentration of at least 3 times or more. Therefore, it is completely reversed to P type, and the impurity range of n mold currently formed beforehand functions as an impurity range of P type.
[0081] Next, after removing the resist mask 332, n mold or p mold impurity element added by each concentration is activated. As an activation means, it can carry out by the furnace annealing method, the laser annealing method, or the lamp annealing method. In this example, 550 degrees C and heat treatment of 4 hours are performed among nitrogen-gas-atmosphere mind in an electric heat furnace.
[0082] It is important to eliminate the oxygen in an ambient atmosphere as much as possible at this time. It is because it is hard coming to take ohmic contact behind while the front face of the gate electrode exposed when oxygen existed oxidizes and causing the increment in resistance. Therefore, as for the oxygen density in the processing ambient atmosphere in the above-mentioned activation process, it is preferably desirable to be referred to as 0.1 ppm or less 1 ppm or less.
[0083] Next, if an activation process is completed, the gate wiring 335 of 300nm thickness will be formed. What is necessary is just to use the metal membrane which uses aluminum (aluminum) or copper (Cu) as a principal component (it considers as a presentation and 50 - 100% is occupied.) as an ingredient of the gate wiring 335. It forms so that the gate electrodes 314 and 315 of TFT for switching may be electrically connected as arrangement. (Drawing 3 (D))
[0084] Since wiring resistance of gate wiring can be made very small by considering as such structure, the image display field (picture element part) where area is large can be formed. That is, when the magnitude of a screen realizes EL display of 10 inches or more (30 more inches or more) of vertical angles, the pixel structure of this example is very effective.
[0085] Next, as shown in drawing 4 (A), the 1st interlayer insulation film 336 is formed. What is necessary is just to use the cascade screen which used the insulator layer containing silicon by the monolayer as the 1st interlayer insulation film 336, or was combined in it. Moreover, thickness is just 400nm - 1.5 micrometers. In this example, it considers as the structure which carried out the laminating of the oxidation silicon film of 800nm thickness on the nitriding oxidation silicon film of 200nm thickness.
[0086] Furthermore, in the ambient atmosphere containing 3 - 100% of hydrogen, heat treatment of 1 -

12 hours is performed at 300-450 degrees C, and a hydrogen treating is performed. This process is a process which carries out hydrogen termination of the azygos joint hand of the semi-conductor film by the hydrogen excited thermally. As other means of hydrogenation, plasma hydrogenation (the hydrogen generated by the plasma is used) may be performed. In addition, a hydrogen treating may be put in while forming the 1st interlayer insulation film 336. That is, after forming the nitriding oxidation silicon film of 200nm thickness, a hydrogen treating may be performed as mentioned above, and it may remain after that, and the oxidation silicon film of 800nm thickness may be formed.

[0087] Next, a contact hole is formed to the 1st interlayer insulation film 336, and source wiring 337-340 and the drain wiring 341-343 are formed. In addition, in this example, it considers as the cascade screen of the three-tiered structure which carried out the aluminum film which contains [this electrode] 100nm and Ti for Ti film by 300nm, and carried out continuation formation of the 150nm of the Ti film by the spatter. Of course, other electric conduction film is sufficient.

[0088] Next, the 1st passivation film 344 is formed by the thickness of 50-500nm (typically 200-300nm). In this example, the nitriding oxidation silicon film of 300nm thickness is used as the 1st passivation film 344. A silicon nitride film may be substituted for this.

[0089] In addition, it is effective to perform plasma treatment using the gas which contains H2 and NH3 grade hydrogen in advance of formation of the nitriding oxidation silicon film. The membraneous quality of the 1st passivation film 344 is improved because the hydrogen excited by this pretreatment heat-treats by supplying the 1st interlayer insulation film 336. Since the hydrogen added by the 1st interlayer insulation film 336 at it and coincidence is spread in a lower layer side, a barrier layer can be hydrogenated effectively.

[0090] Next, the 2nd interlayer insulation film 345 which consists of organic resin as shown in drawing 4 (B) is formed. As organic resin, polyimide, a polyamide, an acrylic, BCB (benz-cyclo-butene), etc. can be used. Since especially the 2nd interlayer insulation film 345 has the strong implications of flattening, its acrylic excellent in surface smoothness is desirable. At this example, the acrylic film is formed by the thickness which can fully carry out flattening of the level difference formed of TFT. desirable -- 1-5 micrometers (still more preferably 2-4 micrometers) -- then, it is good.

[0091] Next, the contact hole which reaches the drain wiring 343 is formed in the 2nd interlayer insulation film 345 and the 1st passivation film 344, and the pixel electrode 346 is formed. In this example, the aluminium alloy film (aluminum film containing 1wt% titanium) of 300nm thickness is formed as a pixel electrode 346. In addition, 347 is the edge of an adjoining pixel electrode.

[0092] An example of the thin film deposition system which forms EL layer and an anode plate continuously is shown in drawing 10 . What was shown in drawing 10 is a metal membrane containing the element with which it belongs to a macromolecule system EL layer as the transparence electric conduction film and a luminous layer, and it belongs to one group of a periodic table, or two groups as catholyte as an anode plate, and equipment which forms a silicon nitride film and the nitriding oxidation silicon film continuously as the 2nd passivation layer.

[0093] In drawing 10 , 401 is a conveyance room which performs carrying in or taking out of a substrate, and is also called a load unload room. The carrier 402 which set the substrate here is arranged. In addition, the conveyance room 401 may be distinguished from the object for substrate carrying in, and the object for substrate taking out. Moreover, 403 is a community room including the device (henceforth a conveyance device) 405 in which a substrate 404 is conveyed. The robot arm which handles a substrate is a kind of the conveyance device 405.

[0094] And two or more processing rooms (shown by 407-411) are connected with the community room 403 through Gates 406a-406f. With the configuration of drawing 10 , the community room 403 is decompressed from Number mTorr to dozens mTorr(s), and each processing room is intercepted by Gates 406a-406f in the community room 403. In this case, since the processing room 408 for solution spreading is performed by the ordinary pressure which filled inert gas, it has the composition of having formed the processing room 401 for evacuation between the community room 403 and the processing room 408 for solution spreading.

[0095] Therefore, it becomes possible to perform processing under a vacuum by forming an exhaust air

pump in each processing room. Although it is possible as an exhaust air pump to use an oil sealed rotary pump, a mechanical booster pump, a turbo molecular pump, or cryopump, cryopump effective for removal of moisture is desirable.

[0096] The processing room (henceforth the processing room for the 3rd membrane formation) for forming catholyte is shown by 407. Here, formation of the auxiliary electrode for assisting cathode is performed. Moreover, although vacuum deposition or a spatter is used, since vacuum deposition cannot give a damage easily, it is desirable. Anyway, it is intercepted by gate 406b with the community room 403, and membrane formation is performed under a vacuum.

[0097] In addition, to perform vacuum deposition as a gaseous-phase forming-membranes method, it is necessary to prepare the source of vacuum evaporationo. Although the metal membrane well used as catholyte is a metal membrane containing the element belonging to one group of the periodic table, or two groups, since these metal membranes tend to oxidize, it is desirable to protect a front face. Moreover, since required thickness is also thin, the low electric conduction film of resistivity is prepared auxiliary, resistance of cathode is lowered, and, in addition, protection of cathode is aimed at. The metal membrane which uses aluminum, copper, or silver as a principal component as low electric conduction film of resistivity is used. Here, lithium fluoride is used for the electronic injection layer 348 shown in drawing 4 (C), and it forms in the thickness of 5nm with a vacuum deposition method.

[0098] Next, the processing room (henceforth the processing room for solution spreading) which applies the solution which contains a macromolecule system EL ingredient with a spin coat method is shown by 408. Since EL ingredient is very weak for moisture as mentioned above, the processing room 408 for solution spreading has the holding [to an inert atmosphere]-always need.

[0099] Conveyance of a substrate decompresses the processing room 412 for evacuation to the same pressure as the community room 403 first, opens gate 406d in the condition, and conveys a substrate. And after shutting gate 406d, when the inside of the processing room 412 for evacuation is purged with inert gas and it returns to ordinary pressure, the gate 413 is opened and a substrate is conveyed to the processing room 408 for solution spreading. This conveyance is good in a line the whole stage, and the conveyance means of dedication may perform it.

[0100] The means which carries out optimum dose supply of the solvent containing the fixed head and the macromolecule system EL compound which are made to hold and rotate a substrate on a substrate is formed in the processing room 408 for liquid spreading. Although a vacuum-chuck method is adopted as a simple configuration, in accordance with the configuration of suction opening, as for the fixed head, spots will be made as for a substrate to the thickness of distortion and EL layer applied. Although EL layer is formed by the thickness of 100-200nm, the variation in thickness brings about deterioration of display grace, such as variation in luminescence reinforcement.

[0101] Drawing 11 shows the configuration of the fixed head which makes such spots the minimum. The configuration of suction opening is a configuration where the slot on the concentric circle or two or more puncturing were prepared, carries out ****** from connection opening prepared in the bottom of suction opening, and is distributing the suction force two-dimensional. A superior lamella and an inferior lamella are united and such the fixed head is constituted.

[0102] Drawing 11 (A) is the plan of the superior lamella 1101 of the fixed head, and the concentric circular puncturing 1103 is formed. This drawing (B) is an inferior lamella 1102, and cross-joint-like the common slot 1104 and an exhaust port 1105 are formed. This drawing (C) shows the sectional view which met superposition and an A-A' line in the superior lamella 1101 and the inferior lamella 1102. Moreover, drawing 11 (D) is other examples and two or more puncturing 1108 is formed in the superior lamella 1106 of the fixed head. This drawing (E) is an inferior lamella 1107, and circle-like the common slot 1109 and an exhaust port 1110 are formed. This drawing (F) shows the sectional view which met superposition and a B-B' line in the superior lamella 1106 and the inferior lamella 1107.

[0103] In this example, PVK (polyvinyl carbazole), Bu-PBD (2-(4'-tert-buthylphenyl)- 5-(4"-biphenyl)-1, 3, 4-OKISA diazole), a coumarin 6, DCM1 (4-dicyanomethylene -2 - methyl-6-p-dimethylaminostyryl-4H-pyran) and TPB (tetra-phenyl butadiene), and the Nile red are dissolved in 1 and 2-dichloromethane or chloroform, and it applies with a spin coat method. Consider as 500 -

1000rpm extent, it is made to rotate for 20 - 60 seconds, and a rotational frequency forms the uniform spreading film.
[0104] Of course, after each above-mentioned organic compound performs five purification or more (typically dialysis) and sets concentration of the ionicity impurity contained to 0.1 ppm or less (preferably 0.01 ppm or less) preferably at least 3 times or more, it forms membranes. The concentration of the ionicity impurity contained in the luminous layer 349 shown in drawing 4 (C) by carrying out like this is set to 0.1 ppm or less (preferably 0.01 ppm or less), and a volume-resistivity value serves as 1x1011 - 1x1012-ohmcm (preferably 1x1012 to 1x1013-ohmcm).
[0105] And if a solution spreading process is completed, the gate 413 will be opened, a substrate will be conveyed to the processing room 412 for evacuation, and evacuation will be performed where gate 413 and gate 406d is shut. If the processing room 412 for evacuation reaches even the same reduced pressure condition as the community room 403, gate 406d will be opened and a substrate will be conveyed to a community room.
[0106] In addition, although the processing room 409 for baking is formed here, as the susceptor of the processing room 412 for evacuation can be heated, a baking process may be performed here. It is possible to stop degasifying by carrying out evacuation after baking.
[0107] Next, the processing room (henceforth the processing room for the 1st membrane formation) for forming an anode plate is shown by 410. Although mentioned as vacuum deposition or technique with a suitable spatter as a forming-membranes method, since it is used in order to form an anode plate 350 on a luminous layer 349 here, it is required that a damage should not be given. In a spatter, it carries out using targets, such as the above-mentioned ITO, a compound of indium oxide and a zinc oxide, and SnO2 or ZnO. Membranous thickness is set to 30-300nm.
[0108] Moreover, in forming membranes by the spatter, a coat forming face (field in which the luminous layer was formed) may be upward (face-up method), or may be downward (face down method). In the case of a face-up method, it is very simple in order for what is necessary to be just to install the substrate conveyed from the community room 403 in a susceptor as it is. Although a conveyance device becomes complicated since it will be necessary to have a device for making the conveyance device 405 or the processing room 410 for the 1st gaseous-phase membrane formation reverse a substrate in the case of a face down method, the advantage that there is little adhesion of dust is acquired.
[0109] In addition, to perform vacuum evaporationo processing at the processing room 410 for the 1st membrane formation, it is necessary to provide the source of vacuum evaporationo. Two or more sources of vacuum evaporationo may be prepared. Moreover, it is good also as a source of vacuum evaporationo of a resistance heating method, and good also as a source of vacuum evaporationo of EB (electron beam) method.
[0110] Next, the processing room (henceforth the processing room for the 2nd membrane formation) for forming the 2nd passivation film is shown by 411. The 2nd passivation film forms a silicon nitride film and the nitriding oxidation silicon film by the plasma-CVD method. Therefore, although not illustrated, a plasma generating means, a substrate heating means, etc. using gas supply systems, such as SiH4, N2O, and NH3, and a 13.56-60MHz RF generator are established. Since EL layer is weak by moisture or moisture, it is good to prepare such passivation film continuously, without exposing EL layer to the atmospheric-air ambient atmosphere after formation.
[0111] Although the laminated structure which consists of the electronic injection layer 348 and luminous layer 349 which are shown in drawing 4 (C) as an EL layer is used in this example, an electronic transportation layer, an electron hole transportation layer, a hole injection layer, an electronic blocking layer, or an electron hole blocking layer may be prepared if needed.
[0112] The 2nd passivation film 351 which becomes with the silicon nitride film formed by the plasma-CVD method is formed in the thickness of 100nm. This 2nd passivation film 351 protects a luminous layer 349 from moisture etc. Moreover, the role which misses the heat generated in the luminous layer 349 is also played. In order to heighten the heat dissipation effectiveness further, it is also effective to carry out the laminating of a silicon nitride film and the carbon film (preferably diamond-like carbon film), and to consider as the 2nd passivation film.

[0113] In this way, the active-matrix mold EL display of structure as shown in drawing 4 (C) is completed. By the way, by arranging TFT of the optimal structure not only for a picture element part but the drive circuit section, the active-matrix mold EL display of this example shows very high dependability, and its operating characteristic may also improve.
[0114] First, TFT which has the structure of reducing hot carrier impregnation so that a working speed may not be reduced as much as possible is used as an n channel mold TFT205 of the CMOS circuit which forms a drive circuit. In addition, as a drive circuit here, a shift register, a buffer, a level shifter, a sampling circuit (sample and hold circuit), etc. are included. In performing a digital drive, signal transformation circuits, such as a D/A converter, are also included and it gets.
[0115] In the case of this example, as shown in drawing 4 (C), in the LDD field 357, the barrier layer of the n channel mold 205 has lapped with the gate electrode 313 through gate dielectric film 311 including the source field 355, the drain field 356, the LDD field 357, and the channel formation field 358.
[0116] The consideration for not reducing a working speed forms the LDD field only in a drain field side. Moreover, it is better for this n channel mold TFT205 to seldom have cared about the OFF state current value, and to attach greater importance than to it to a working speed. Therefore, as for the LDD field 357, it is desirable to keep in a gate electrode in piles completely, and to lessen a resistance component as much as possible. Namely, it is better to abolish the so-called offset.
[0117] Moreover, since degradation by hot carrier impregnation hardly worries the p channel mold TFT206 of a CMOS circuit, it is not necessary to prepare especially a LDD field. Of course, it is also possible to prepare a LDD field like the n channel mold TFT205, and to take the cure against a hot carrier.
[0118] In addition, if it completes to drawing 4 (C) in fact, EL layer will be enclosed with a closed space using the opposite substrate which has a light-shielding film as drawing 1 explained. In that case, the interior of a closed space is made into an inert atmosphere, or the dependability (life) of EL layer improves by arranging a hygroscopic material (for example, barium oxide) inside. Enclosure processing of this EL layer may divert the technique used for the cel **** process of a liquid crystal display to some other purpose.
[0119] Moreover, if enclosure processing of EL layer is completed, the connector (flexible print circuit: FPC) for connecting the terminal and external signal terminal which were taken about from the component formed on the substrate or the circuit will be attached, and it will complete as a product.
[0120] Next, the configuration of the active-matrix mold EL display of this example is explained using the perspective view of drawing 5 . The active-matrix mold EL display of this example consists of a picture element part 602 formed on the glass substrate 601, a gate side drive circuit 603, and a source side drive circuit 604. TFT605 for switching of a picture element part is the n channel mold TFT, and is arranged at the intersection of the gate wiring 606 connected to the gate side drive circuit 603, and the source wiring 607 connected to the source side drive circuit 604. Moreover, the drain of TFT605 for switching is connected to the gate of TFT608 for current control.
[0121] Furthermore, the source of TFT608 for current control is connected to the current supply line 609. The predetermined electrical potential difference is given to the current supply line 609 with structure like this example. Moreover, EL element 610 is connected to the drain of TFT608 for current control. Moreover, since the cathode of EL element 610 is connected to the drain, as TFT608 for current control, it is desirable to use the n channel mold TFT.
[0122] And the connection wiring 612 and 613 for transmitting a signal to a drive circuit and the connection wiring 614 connected to the current supply line 609 are formed in FPC611 used as an external I/O terminal.
[0123] Furthermore, EL display of this example is explained using drawing 6 (A) and (B). A substrate 1000 is a active-matrix substrate and the picture element part 1001, the source side drive circuit 1002, and the gate side drive circuit 1003 are formed on the substrate. Various wiring from each drive circuit results in FPC611 through the connection wiring 612-614, and is connected to an external instrument.
[0124] this time -- at least -- a picture element part -- as a drive circuit and a picture element part are surrounded preferably, the opposite substrate 1004 is formed. In addition, the opposite substrate 1004 is

pasted up so that a closed space 1006 may be formed in collaboration with the active-matrix substrate 1000 with adhesives (sealing compound) 1005. At this time, an EL element will be in the condition of having been completely enclosed with said closed space 1006, and will be intercepted from the open air.

[0125] Moreover, although the epoxy system resin of a photoresist is used as adhesives 1005 in this example, it is also possible to use adhesives, such as acrylate system resin. Moreover, thermosetting resin can also be used if the thermal resistance of EL layer allows. However, it is required to be the quality of the material which does not penetrate oxygen and moisture as much as possible. What is necessary is just to form adhesives 1005 using coaters, such as a dispenser.
[0126] Furthermore, nitrogen gas is filled up with this example into a closed space 1006 between the opposite substrate 1004 and the active-matrix substrate 1000. Furthermore, inside the opposite substrate 1004 (closed-space side), as drawing 1 explained, the light-shielding film 1007 and the color filter 1008 are formed, and in this example, the barium oxide and the resin film which made red and a green or blue pigment contain the resin film which made the black pigment contain as a color filter 1008 are used as a light-shielding film 1007.
[0127] Moreover, as shown in drawing 6 (B), two or more pixels which have the EL element isolated separately in a picture element part are prepared, and they are all using the anode plate 1009 as the common electrode. It is not necessary to prepare EL layer on a drive circuit that what is necessary is to prepare only a picture element part at this time. What is necessary is just to use the vacuum deposition using a shadow mask, the lift-off method, the dry etching method, or the laser scribe method, in order to prepare EL layer alternatively.
[0128] An anode plate 1009 is electrically connected to the connection wiring 1010. The connection wiring 1010 is a current supply line for giving a predetermined electrical potential difference to an anode plate 1009, and is electrically connected to FPC611 through the conductive paste ingredient 1011. In addition, although the connection wiring 1010 was explained here, other connection wiring 612-614 is similarly connected to FPC611 electrically.
[0129] The condition which shows in drawing 6 which was explained above can display an image on a picture element part by connecting FPC611 to the terminal of an external instrument. In this specification, the module containing the goods which will be in the condition in which image display is possible, i.e., the goods which stuck the active-matrix substrate and the opposite substrate, (the condition that FPC is attached is included) is defined by attaching FPC as EL display.
[0130] [Example 2] this example shows this invention to drawing 7 about the example at the time of carrying out to a passive-matrix mold EL display. In drawing 7 , it is the cathode where 701 becomes with a plastic plate and 702 becomes by the laminated structure (the part which touches EL layer is the lithium fluoride film) of the aluminum film and the lithium fluoride film. In this example, cathode 702 is formed with vacuum deposition. In addition, although not illustrated in drawing 7 , two or more cathode is arranged in the shape of a stripe in the direction perpendicular to space.
[0131] On cathode 702, the EL layer (only luminous layer) 703 which consists of a macromolecule system EL compound is formed of print processes. In this example, PVK (polyvinyl carbazole), Bu-PBD (2-(4'-tert-buthylphenyl)- 5-(4"-biphenyl)- 1, 3, 4-OKISA diazole), A coumarin 6, DCM1 (4-dicyanomethylene -2 - methyl-6-p-dimethylaminostyryl-4H-pyran), After dissolving TPB (tetra-phenyl butadiene) and the Nile red in 1 and 2-dichloromethane and imprinting on cathode 702 by print processes, it calcinates and the EL layer 703 of white luminescence is formed.
[0132] Of course, after the above-mentioned macromolecule system EL compound performs five purification or more (typically dialysis) and sets concentration of the ionicity impurity contained to 0.1 ppm or less (preferably 0.01 ppm or less) preferably at least 3 times or more, it forms membranes. The concentration of the ionicity impurity contained in the EL layer 703 by carrying out like this is set to 0.1 ppm or less (preferably 0.01 ppm or less), and a volume-resistivity value serves as 1x1011 to 1x1012-ohmcm (preferably 1x1012 to 1x1013-ohmcm).
[0133] In addition, although the EL layer 703 is made into the monolayer structure of only the above-mentioned luminous layer in this example, an electronic injection layer, an electronic transportation

layer, an electron hole transportation layer, a hole injection layer, an electronic blocking layer, or an electron hole component layer may be prepared if needed.
[0134] If the EL layer 703 is formed, the anode plate 704 which becomes by the transparence electric conduction film will be formed. In this example, the compound of indium oxide and a zinc oxide is formed with vacuum deposition as transparence electric conduction film. In addition, although not illustrated in drawing 7 , it is arranged in the shape of a stripe so that the direction where two or more anode plates are perpendicular to space may turn into a longitudinal direction and it may intersect perpendicularly with cathode. Moreover, although not illustrated, wiring is pulled out to the part in which FPC is attached behind so that an electrical potential difference predetermined in an anode plate 704 may be applied.
[0135] If an anode plate 704 is formed, the silicon nitride film of 100nm thickness will be formed as passivation film 705. In case this pastes up covering material etc. behind, it is a protective coat for the EL layer 704 to be unable to touch the open air.
[0136] An EL element is formed on a substrate 701 as mentioned above. Next, a plastic sheet is prepared as covering material 706, and a light-shielding film 707 and a color filter 708 are formed in the front face. A light-shielding film 707 uses the resin with which a color filter 708 contains the pigment corresponding to red and green or blue each using the resin containing carbon. The membrane formation approach should just use the ink jet method, a spin coat method, or print processes.
[0137] Moreover, in order that the light emitted from the EL element with the structure of this example may penetrate the covering material 706 and may go into a watcher's eyes, the covering material 706 is translucency. What is necessary is just to use translucency substrates (or translucency film), such as a glass plate and a PVF film, although the plastic sheet is used in this example.
[0138] In this way, if the covering material 706 is prepared, the covering material 706 will be stuck through the filler (it functions as adhesives) 710 which added the desiccating agent 709. A lamination process should just use the lamination equipment of a duplex vacuum method used for production of a solar battery. Then, a frame material 712 is attached using the sealant 711 which becomes with ultraviolet-rays hardening resin. In this example, stainless steel material is used as a frame material 712. Finally FPC713 is attached and EL display is completed.
[0139] Since EL display formed by carrying out [example 3] this invention is a spontaneous light type, it is excellent in the visibility in a bright location compared with a liquid crystal display, and moreover, its angle of visibility is large. Therefore, it can use as a display of various electronic instruments. For example, it is good to use EL indicating equipment of this invention for appreciating TV broadcast etc. by the big screen as a display of the EL display (display which built EL indicating equipment into the case) of 30 inches or more (typically 40 inches or more) of vertical angles.
[0140] In addition, all displays for information displays, such as a PC monitor, a display for TV broadcast reception, and a display for an advertising display, are included in an EL display. Moreover, in addition to this, EL display of this invention can be used as a display of various electronic instruments.
[0141] As such an electronic instrument, a video camera, a digital camera, a goggles mold display (head mount display), A car-navigation system, a sound system (audio), a note type personal computer, A game device, a Personal Digital Assistant (a mobile computer, a cellular phone, a handheld game machine, or digital book), The picture reproducer (equipment equipped with the display which specifically reproduces record media, such as a compact disk (CD), a laser disc (trademark) (LD), or a digital videodisc (DVD), and can display the image) equipped with the record medium etc. is mentioned. Since importance is attached to the size of an angle of visibility, as for especially the Personal Digital Assistant with seeing [much] from across, it is desirable to use EL display. The example of these electronic instruments is shown in drawing 8 .
[0142] Drawing 8 (A) is an EL display and contains a case 2001, susceptor 2002, and display 2003 grade. This invention can be used for a display 2003. Since it is a spontaneous light type, the back light of an EL display is unnecessary, and it can be made into a display thinner than a liquid crystal display.
[0143] Drawing 8 (B) is a video camera and contains a body 2101, a display 2102, the voice input section 2103, the actuation switch 2104, a dc-battery 2105, and television section 2106 grade. EL

display of this invention can be used for a display 2102.
[0144] Drawing 8 (C) is a part of EL display (right one side) of a head installation mold, and contains a body 2201, a signal cable 2202, the head fixed band 2203, a display 2204, optical system 2205, and EL display 2206 grade. This invention can be used for the EL display 2206.
[0145] Drawing 8 (D) is the picture reproducer (specifically DVD regenerative apparatus) equipped with the record medium, and contains a body 2301, record media (CD, LD, or DVD) 2302, the actuation switch 2303, a display (a) 2304, and (Display b) 2305 grade. Although a display (a) mainly displays image information and a display (b) mainly displays text, EL display of this invention can be used for these displays (a) and (b). In addition, CD regenerative apparatus, a game device, etc. are contained in the picture reproducer equipped with the record medium, and it sells to it.
[0146] Drawing 8 (E) is a pocket mold (mobile) computer, and contains a body 2401, the camera section 2402, the television section 2403, the actuation switch 2404, and display 2405 grade. EL display of this invention can be used for a display 2405.
[0147] Drawing 8 (F) is a personal computer and contains a body 2501, a case 2502, a display 2503, and keyboard 2504 grade. EL display of this invention can be used for a display 2503.
[0148] In addition, if the luminescence brightness of EL ingredient will become high in the future, it will also become possible to carry out expansion projection of the light containing the outputted image information with a lens etc., and to use for the projector of a front mold or a rear mold.
[0149] Moreover, the above-mentioned electronic instrument displays more often the information distributed through electronic communication lines, such as the Internet and CATV (cable television), and its opportunity to display especially animation information has been increasing. Since the speed of response of EL ingredient is very high, EL display is desirable to a movie display, but if the profile between pixels fades, the whole animation will also fade. Therefore, it is very effective to use EL display of this invention of making the profile between pixels clear, as a display of an electronic instrument.
[0150] Moreover, in order that the part which is emitting light may consume power, as for EL display, it is desirable to display information that the amount of light-emitting part decreases as much as possible. Therefore, when using EL display for the display which is mainly concerned with text like a Personal Digital Assistant especially a cellular phone, or a car audio, it is desirable to drive so that text may be formed by part for a light-emitting part by making a nonluminescent part into a background.
[0151] Drawing 9 (A) is a cellular phone and contains a body 2601, the voice output section 2602, the voice input section 2603, a display 2604, the actuation switch 2605, and an antenna 2606 here. EL display of this invention can be used for a display 2604. In addition, a display 2604 can stop the power consumption of a cellular phone by displaying a white alphabetic character on a black background.
[0152] Moreover, drawing 9 (B) is a car audio and includes a body 2701, a display 2702, and the actuation switches 2703 and 2704 in a sound system and a concrete target. EL display of this invention can be used for a display 2702. Moreover, although this example shows the car audio for mount, you may use for a non-portable audio. In addition, a display 2704 can stop power consumption by displaying a white alphabetic character on a black background. Especially this is effective in the audio of a pocket mold.
[0153] As mentioned above, the applicability of this invention is very wide, and using for the electronic instrument of all fields is possible. Moreover, EL display of which configuration shown in examples 1-3 may be used for the electronic instrument of this example.
[0154]
[Effect of the Invention] Degradation of an EL element can be controlled by carrying out this invention, and the dependability of EL display can be raised. Moreover, the dependability of an electronic instrument can be raised by using EL display of this invention as a display of an electronic instrument.

[Translation done.]